PATENT
File No. 1200212R

# MOLDED PRODUCTS WITH MATTE FINISH AND METHOD OF MAKING SAME

## Claim of Priority

This application claims priority from U.S. Provisional Patent Application Serial Number 60/418,543 bearing Attorney Docket Number 1200212 and filed on October 15, 2002.

## Field of the Invention

This invention relates to a molded product having a matte finish and a method of making such product.

## Background of the Invention

Modern consumer products demand eye-catching attention. Producers of consumer products compete for available shelf space in retail businesses. The outer appearance of a product, including its shape, color, texture, and labeling is the first impression for a consumer. Producers undertake considerable efforts to display a desired appearance to attract the consumer to the product. Such outer appearance, over time and with exclusivity, achieves a form of intellectual property for the producer, called trade dress, which offers a visual differentiation for commodity products and another differentiation for unique products.

Thermoplastic resins are used for the production of consumer products. Ranging from the clear, plastic, large soft drink bottles to the miniature colored cosmetic vials, polyethylene terephthalate (PET or polyester) as a resin has been frequently used because of its low cost and ability to be compounded with

colorants. Most importantly, PET can be formed into products by conventional blow-molding techniques.

Molded products made by the blow-molding techniques take the shape and outer texture according to the mold used.

Summary of the Invention

What the art needs is a molded product that can be replicated in a shape and outer appearance that combines the visual and tactile sensations of a matte finish.

The present invention solves this problem by providing a durable means to produce a molded product with a matte finish.

One aspect of the present invention is a molded thermoplastic product having an outer surface with a matte finish, wherein the matte finish is produced by a combination of an etched mold in which the product is molded to physically affect the outer surface and a colorant compounded in the thermoplastic to chemically affect the outer surface.

"Matte finish" means a lusterless surface. In respect of transparent, semi-transparent, or translucent thermoplastic polymers, a matte finish provides a diffused translucent effect in a manner analogous to frosted or etched surfaces on glass.

In the packaging business, there is a move away from glass containers toward plastic containers to reduce personal injury and property damage caused by breaking glass. Therefore there is a need in art for outer surfaces of a thermoplastic container to have an appearance similar to a frosted or etched glass appearance. The present invention fills that need in a manner that achieves essential durability of the production of the molded containers to satisfy demanding conditions of quality control for consumer packaging.

Another aspect of the present invention is a method of making the molded thermoplastic product described above, comprising the steps of (a) etching a mold in a manner to provide a physical texture; (b) compounding a

colorant into a thermoplastic resin; and (c) blow-molding the thermoplastic resin in the etched mold.

A feature of the present invention is the generation of a matte finish on a blow-molded thermoplastic product using a combination of an etched mold and a chemical colorant where neither the mold nor the colorant alone achieves the same appearance.

Another feature of the present invention is the ability to provide differing matte finish appearances on the blow-molded thermoplastic product by using the both the mold and the colorant effects in one area, in combination with the use of mold effect alone, the use of the colorant effect alone, or neither in other area(s). For example, a blow-molded PET container can have an etched/colorant effect on the lower half of the container and a colorant-alone effect on the upper half of the container. Creating an etched surface on the mold only in that area where the lower half of the container is to be formed makes that container.

An advantage of the present invention is the ability to customize matte finish appearance effects for trade dress protection of consumer packaging.

Another advantage of the present invention is the ability to replicate matte finish appearance effects with essentially the same quality control throughout a production run of a thermoplastic product, because the mold is physically etched in a controlled manner.

Other features and advantages will be explained in connection with the embodiments of the invention.

## Embodiments of the Invention

### Thermoplastic Resins

The thermoplastic product uses conventional thermoplastic resins having properties known to those skilled in the art. Desired properties include transparency, semi-transparency, and translucency. Non-limiting examples of

thermoplastic resins include polyethylene terephthalate (PET); cyclohexanedimethanol-modified PET (PETG); styrene acrylonitrile copolymer (SAN); general purpose styrene (GPS); polycarbonate (PC); and combinations thereof.

Conventional formulations for compounding of these thermoplastic resins into blow-molded products are well known to those skilled in the art of blow molding.

Colorant

Colorant useful in the present invention are those which generate the look of frosted glass on the outer surface of the blow-molded thermoplastic product. A commercially available colorant to achieve this "frosted glass" effect via in-mold processing without additional procedures is Hanna FX Frost Colorant from PolyOne Corporation (www.polyone.com). The Hanna FX Frost Colorant is shipped in a pelletized form. The pellets can be added to the thermoplastic resin and other materials in the formulation via conventional feeding equipment. The equipment accurately feeds the materials in a manner to achieve a uniform or even effect of the frosted glass appearance throughout the thermoplastic product so molded.

The Hanna FX Frost Colorant does not cause an alteration of the mold surface or the surface gloss on the molded part. Rather, the frosted glass appearance is a function of the chemistry of this additive in the thermoplastic compound.

The Hanna FX Frost Colorant is available to make an uncolored frosted-glass effect, called Frost Natural. Custom colors can be formulated in a range of hues for a colored frost look. A satin or sparkle frost effect also is available. These Hanna FX Frost colorants are formulated to be compatible with all transparent polymers.

The amount of colorant to be added to the thermoplastic resin can range from about 0.01 to about 15 parts by weight, and preferably from about 0.2 to 5 parts by weight. Additional information about the colorant and the

thermoplastic resins is found in United States Patent Application Serial Nos. 08/876,003 (Phillips) and 09/480,955 (Phillips), the disclosures of which are incorporated by reference herein and in PCT Patent Publication WO 98/56850 (Hanna).

Mold Etching

Conventionally, a matte finish has been made using sandblasted or glass-bead-blasted molds. The present invention uses etched molds to reduce the possibility of metal fatigue in the mold during repeated uses, leading to an erosion of textured appearance on the molded part.

The texture of the outer surface of a blow-molded product is dependent on the selection of etching pattern or etching technique within the inner surface of the mold. Etching patterns combine artistry of final appearance with technology of generating the pattern. Such skills are known to those in the art.

Microreplication is one technique. Microreplication can be used in this invention to prepare the mold to have a microembossed pattern. Desired embossing topography can be formed in tools via any of a number of well-known techniques, selected depending in part upon the tool material and features of the desired topography. Illustrative techniques include etching (e.g., via chemical etching, mechanical etching, or other ablative means such as laser ablation or reactive ion etching, etc.), photolithography, stereolithography, micromachining, knurling (e.g., cutting knurling or acid enhanced knurling), scoring or cutting, etc.

Metal etching is a technique used in the semiconductor industry and has achieved a high degree of precision. Non-limiting examples of such commercial sources of metal etching include Lam Research Corporation of Fremont, California which uses plasma etching; Semitool Inc. of Kalispell, Montana which uses chemical reagent etching involving an oxidation-reduction reaction; and MKS Instruments, Inc. of Andover, Massachusetts which uses chlorine to etch aluminum. A commercially proficient source of etched molds is Akron Metal Finish Company of Akron, Ohio, which uses chemicals to

remove metal from the mold surface to form a distinct pattern that replicates a texture on the outer surface of the molded product.

Etching of the mold also determines the level of coarseness and depth of the resulting outer surface of the molded part. Etching produces depressions and lands, i.e., the unetched mold inner surface. The depth of the depressions can range from about 0.1 μm to about 100 μm, and preferably from about 0.5 μm to about 10 μm. The ratio of depressions to lands in surface area can range from about 1 to 90 percent and preferably from about 50 to 80 percent. While a grid of depressions forming lands is most common, other angles can be employed to provide a knurled surface, etc.

The "sidewalls" of depressions can be any shape desired, ranging from a constant radius of curvature to any polygonal shape of at least 2 surfaces. Nonlimiting examples of shapes of etching, in cross-section, include curved, rectangular, trapezoidal, triangular, bimodal, and the like.

The width of depressions in any pattern, or any combination of them, can vary as needed. For example, the width of depressions that define lands can be relatively uniform for the mold's surface or can be varied to achieve any aesthetic appearance.

Optionally, the mold can also be subjected to conventional sandblasting or glass-bead blasting in addition to the etching.

The mold can be made from metals suitable for etching, such as aluminum, titanium, and the like.

Blow Molding

Molding equipment can be used to make large production runs of the molded product or prototype samples. For example, an Aoki Stretch Blow Molding machine from Aoki Technical Laboratory, Inc. of Nagano, Japan and Aoki Laboratory America of Elk Grove Village, Illinois can be used to produce sample bottles for customer trials and other consumer marketing evaluations. Such sample bottles are preferable to color chips for customer evaluation.

Blow-molding techniques known to those skilled in the art can affect the visual and tactile sensations of the matte finish achieved according to the present invention. For example, without undue experimentation, one skilled in the art can achieve variations in matte finish appearance by alterations in such parameters as pre-forming, gauge or other thickness measurement, and the like.

Conventional blow-molding techniques known to those skilled in the art can be used in the present invention, once the combination of an etched mold and a colorant are employed in the preparation for production.

Usefulness of the Invention

As explained with reference to Hanna FX Colorants, consumer products suitable for the use of a matte finish include packaging, containers, cosmetics, housewares, toys, outdoor furniture, computer and printer housings, jewel boxes, vases, light fixtures, backlighting, signs, buttons, personal electronic products and other products, to the extent that such products are produced using blow-molding techniques.

A particularly preferred use of the products of the present invention is in the health and beauty aid (HBA) business where product container appearance is important for trade dress benefits to the producer of the health or beauty aid product.

The invention is not limited to the above embodiments. The claims follow.